



DOSSIER · THERAPY

Forest Bathing (Shinrin-Yoku)

Forest bathing is a Japanese practice in which time is deliberately spent in forests to achieve health effects. The data situation in humans is extensive, but controlled studies make up only a small part. The most interesting finding: The majority of the studies examine **exhaustion and cognition**, while other areas of application provide hardly any reliable data.

578

STUDIES IN
TOTAL

243

IN HUMANS

48

OF WHICH
CONTROLLED

0

IN ANIMALS

1

IN THE LAB

Figures from the IHR study database · Last updated 2026-10-04

How to Read This Dossier

ESTABLISHED

measured in humans, with a comparison group

PLAUSIBLE

supported by mechanism, animal studies or observation

HYPOTHESIS

a likely connection that still needs to be tested

Forest Bathing (Shinrin-yoku) at a Glance

ORIGIN:

Forest bathing (Japanese *Shinrin-yoku*) is a procedure developed in Japan in the 1980s in which mental and physical health is to be promoted through mindful time spent in forests. The focus lies on sensory exposure to the forest atmosphere, including volatile organic compounds (phytoncides), odours and visual stimuli, without standardised execution or defined dose.

EVIDENCE BASE:

578 evaluated studies · 48 controlled human studies · 195 observational studies · 105 review articles · 0 animal studies · 1 cell-culture study

STRONGEST EVIDENCE:

- **Exhaustion and stress** Controlled studies show significant reductions in salivary cortisol, pulse rate and sympathetic activity as well as increases in parasympathetic activity after forest stays. Subjective stress parameters and mood images improve measurably, although often without active control groups.
- **Cognition and psyche** Review articles report large effect sizes (e.g. 1.25) for improvements in anxiety, depression and mood after forest-based interventions. Studies with fibromyalgia patients provide indications of significant reductions in functional impairment and psychological distress, although in studies with additional therapy elements.
- **Heart and circulation:** Systematic reviews and meta-analyses show significant reductions in systolic and diastolic blood pressure after forest stays. Effects are clinically relevant, yet heterogeneous due to varying intervention durations and lack of standardisation of forest environments.
- **Inflammatory processes:** Randomised controlled studies provide indications of a significant reduction in inflammatory markers (IL-6, TNF-α) in older hypertension patients after 7-day forest stays. Whether this changes inflammatory diseases remains to be clarified. Methodological limitations restrict the strength of the statements.

LIMITATIONS:

- Most controlled studies have small sample sizes, often without blinded designs or active control groups. Placebo effects and expectation attitudes are not excluded.
- Application areas such as metabolism, musculoskeletal system or gut microbiome are scarcely investigated. Reproducibility suffers from lack of standardisation of forest environments and intervention durations.
- Cell-culture studies on mechanisms (e.g. phytoncides) provide preclinical indications, yet are not transferable to practice. Causal effects are rarely proven, as many studies are based on correlations.

CLASSIFICATION:

Forest bathing is a Japanese procedure with indications of stress-reducing and mentally stabilising effects. Cardiovascular and immunological effects require further clarification through standardised studies with active control groups.

1. What Forest Bathing Is

Forest bathing (Japanese *Shinrin-yoku*) denotes conscious time spent in forest areas with the aim of promoting mental and physical health. Developed in Japan in the 1980s, it comprises no specific exercises but rather the mindful perception of the surroundings – for example through walking, sitting or perception exercises. Duration varies; stays of several hours are typical. In contrast to sport or recreation outdoors, the emphasis is not on physical activity but on **sensory exposure** to the forest atmosphere, including volatile organic compounds (*phytoncides*), odours and visual stimuli.

The **execution** is not standardised: studies use different forest types (deciduous, coniferous, mixed forests), seasons, times of day and accompanying activities (e.g. meditation, breathing exercises). Mainly **subjective parameters** such as mood or stress perception as well as **physiological markers** such as heart-rate variability, cortisol level or immune parameters are measured. As no chemical substance or defined dose is present, the comparability of studies depends strongly on the **description of the intervention**. Many studies forgo a detailed characterisation of the forest environment, which restricts reproducibility.

2. What the Studies Show in Detail

The supporting human studies and the most important reviews — by application area, with population, duration, preparation, measured variable and result, as the original studies report them. Numbers appear only where the study states them.

Distribution of the **controlled human studies** by application area — the numbers are not additive, as one study may be assigned to several areas:

APPLICATION AREA	CONTROLLED STUDIES
Exhaustion and stress	28
Cognition and psyche	28
Heart and circulation	11
Safety and tolerability	8
Metabolism	7

APPLICATION AREA	CONTROLLED STUDIES
Immune system	4
Musculoskeletal system	2
Gut and microbiome	2

Inflammatory Processes

In a randomised controlled study (RCT) with 24 older patients (mean age not explicitly stated) with essential hypertension, the effect of a 7-day forest stay ("forest bathing") on inflammation-relevant biomarkers was examined. The intervention group spent 7 days and nights in an evergreen deciduous forest, while the control group remained in an urban environment in Hangzhou. Measured, among other things, were the inflammatory markers interleukin-6 (IL-6) and tumour necrosis factor- α (TNF- α), as well as cardiovascular risk factors such as endothelin-1, homocysteine, renin, angiotensinogen, angiotensin II and its receptors. The results showed a significant reduction in blood-pressure values as well as the inflammatory markers IL-6 and TNF- α in the forest group compared with the control group. The study was, however, subject to limitations such as a small sample and the lack of blinding, which restricts the strength of the statements.

A systematic review from 2017 analysed six RCTs on the health effects of nature interventions, including studies on the effect of forest therapy on inflammatory markers¹. The work comprised various forms of nature intervention, including forest bathing. Three of the six studies reported positive effects on inflammation parameters, whereby the methodological quality of all included studies was rated as high risk of bias ("high risk of bias"). This restricts the generalisability of the results. In addition, detailed information on the specific inflammatory markers and their quantitative changes was lacking.

HYPOTHESIS The available data provide indications that forest bathing could influence inflammatory markers, particularly in individuals with pre-existing cardiovascular risk factors. However, large-scale, longitudinal studies with standardised measurement methods are still pending to investigate these changes and possible dose-response relationships.

Heart and Circulation

A systematic review and meta-analysis from 2017 examined the blood pressure-lowering effect of Shinrin-yoku (forest bathing) based on 20 studies with a total of 732 participants². The included controlled and comparative studies analysed the effect of forest environments on systolic and diastolic blood pressure. The meta-analysis found that both systolic and diastolic blood pressure were significantly lower in the forest environment than in non-natural environments. Effect sizes were not explicitly quantified; the clinical relevance of the blood pressure reduction therefore remains open. Limitations of the analysis included heterogeneity of the study populations, varying intervention durations (from single visits to multi-week programmes) and the lack of standardisation of forest environments.

The participants were divided into two groups: one group completed a forest therapy programme (n = 23) and the other a mountain hiking programme (n = 22). Both interventions extended over an unspecified period and, in this comparative observational study, led to small changes in blood pressure in both groups. Women additionally showed changes in physiological parameters such as increased aerobic capacity and an increase in skeletal muscle mass. However, the study was limited by a small sample size and the absence of a non-intervention control group or randomisation, which restricts the strength of the findings.

A further RCT from 2022 examined the combined effect of a Mediterranean DASH diet (MIND diet) and forest bathing on older Chinese adults with hypertension (n = 72)⁸. The participants were assigned to three groups: MIND diet alone (n = 23), MIND diet combined with forest bathing (n = 25) and a control group (n = 24). After four weeks of intervention, both intervention groups showed a significant reduction in systolic blood pressure, while the combined group additionally showed a significant reduction in anxiety and negative mood states. The study provides an indication of effects of the combined intervention but does not permit conclusions about the specific effect of forest bathing alone. It was also limited by the short intervention duration and the lack of follow-up measurement, so long-term effects remain unclear.

HYPOTHESIS The available studies suggest that forest bathing could represent a promising non-pharmacological intervention for blood pressure reduction, particularly in combination with other health-promoting measures. However, systematic investigation of the optimal duration, frequency and type of forest environment is still pending to derive clear recommendations for clinical practice.

Cognition and Psyche

An RCT from 2020 examined the efficacy of a multimodal therapy programme for fibromyalgia patients (NAT-FM), which included forest bathing as one component³. A total of 169 participants were randomised to either the intervention group (TAU + NAT-FM) or the control group (TAU alone). The 12-week programme comprised pain neuroeducation, exercise therapy, cognitive behavioural therapy, mindfulness and nature activities such as yoga, Nordic walking, nature photography and Shinrin-yoku. The primary endpoint was change in functional impairment (FIQR); secondary endpoints included pain, fatigue, anxiety, depression, physical functioning and stress. The results showed significant improvements in the intervention group regarding functional impairment, pain, fatigue and mental health. However, the study was limited by the absence of an active control group and the combination of multiple interventions, so the specific contribution of forest bathing could not be isolated.

A meta-analysis from 2022 analysed six RCTs on the effect of forest-based interventions on mental health, including anxiety, depression and positive and negative mood states⁹. The included studies comprised a total of 34 outcome variables. The pooled effect size of the forest therapy programmes was 1.25 (95 % CI = 0.93–1.57, p < 0.001), indicating a large and statistically significant effect. However, the studies were characterised by high heterogeneity with regard to populations, intervention duration and measurement instruments. In addition, detailed information on the specific mechanisms underlying the observed effects was lacking.

The participants were surveyed on a forest day and a control day, with mood assessed using the Multiple Mood Scale-Short Form and the State-Trait Anxiety Inventory A-State Scale. The results showed a significant reduction in hostility (p < 0.001) and depression (p < 0.001) as well as an increase in vigour (p = 0.001) on the forest day compared with the control day. However, the study was limited by the absence of randomisation and an active control group, so

selection effects cannot be ruled out.

HYPOTHESIS Individual studies suggest that forest bathing could have positive effects on cognitive function and mental health, particularly in individuals with pre-existing mental stress. Long-term effects and neurobiological mechanisms are still pending.

Immune System

A systematic review from 2021 analysed 13 studies on the effect of forest therapy on immunological laboratory parameters in adults ⁵. The included studies comprised RCTs, non-randomised controlled studies and pre-post studies without a control group. The interventions were divided into two categories: overnight programmes ("lodging-type") and session programmes ("session-type"). Primary outcome measures were the number of natural killer cells (NK cells), their cytotoxic activity and the expression of cytotoxic effector molecules such as granulysin, perforin and granzyme A/B. Most studies reported an improvement in these parameters after the intervention compared with baseline values. However, the studies were limited by small samples, lack of control groups and high heterogeneity with regard to intervention duration and intensity.

A review from 2010 examined the effect of forest bathing on immunological laboratory parameters based on several studies with Japanese adults ²⁰. The participants completed a 3-day/2-night forest therapy programme, with blood and urine samples taken on days 2, 3, 7 and 30 after the intervention. The results showed a significant increase in NK-cell activity as well as in the number of NK cells and lymphocytes expressing granulysin, perforin and granzyme A/B. At the same time, the concentration of adrenaline in urine decreased. The increased NK-cell activity persisted for 30 days after the intervention. However, the study was limited by the absence of a control group, the small sample size and the restriction to laboratory findings, so the clinical relevance of these changes in humans has not been investigated.

HYPOTHESIS The available data provide indications that forest bathing could positively influence NK-cell activity as a preclinical immune parameter. Whether this results in a clinically relevant immune effect is still pending. Large-scale, randomised controlled studies with standardised immune parameters are required to examine these effects.

Fatigue and Stress

An observational study from 2011 examined the physiological and psychological effects of forest bathing in 12 young Japanese men ¹⁹. The participants spent one day in a forest area, with salivary cortisol, pulse rate and heart rate variability (HRV) measured before and after the intervention. The results showed a significant increase in parasympathetic activity and a decrease in sympathetic activity in the forest compared with an urban environment. In addition, cortisol levels and pulse rate decreased significantly. Psychological tests showed an increase in positive mood states and a decrease in negative moods. However, the study was limited by a small, homogeneous sample and the absence of a control group.

A meta-analysis and systematic review from 2024 compared the stress-reducing effects of digital nature (e.g. 360° videos) with real nature, including some studies on forest bathing ¹¹. The work included ten studies with a total of 886 participants on various nature interventions. The results showed that digital nature environments had a similar stress-reducing effect to real nature (SMD = -0.01; 95 % CI: -0.15, 0.12). Subgroup analyses on forest bathing found no significant differences between subjective and physiological stress measures. However, the study was limited by the heterogeneity of the interventions and measurement instruments, so the results must be interpreted with caution.

The participants were randomised to either a 3-hour guided session of a related but independent procedure (forest therapy) or a control group (free day without clinical duties). The results of this study on forest therapy showed no significant differences in burnout symptoms between the groups, which may be due to the short intervention duration and the small sample size. Transferability to forest bathing has not been investigated.

HYPOTHESIS The available data suggest that forest bathing could have stress-reducing effects, particularly through modulation of the autonomic nervous system.

Overall Picture

Some of the available controlled studies suggest that forest bathing (Shinrin-yoku) could have positive effects on various physiological and psychological health parameters. Individual controlled studies showed results in the areas of blood pressure reduction, stress reduction and improvement in mental health. The effects on inflammatory markers, cognitive function and fatigue are promising but still pending. Many studies, including observational studies, have methodological limitations such as small samples, lack of control groups, short intervention durations and high heterogeneity with regard to the type of forest environment and the measured outcomes.

A central deficit of the current research situation is the lack of large-scale, longitudinal studies with standardised measurement methods. In addition, there is a lack of studies that systematically investigate the underlying mechanisms of the observed effects, particularly with regard to neurobiological and immunological processes. The question of which specific components of the forest environment (e.g. vegetation type, air quality, sounds) are responsible for the health effects also remains largely unresolved.

Methodology of the Research Situation

The available studies on forest bathing include randomised controlled trials (RCTs) and observational studies with small to medium sample sizes (mostly between 20 and 200 participants). Intervention durations vary widely, from single visits of a few hours to multi-week programmes. Typical endpoints include physiological parameters such as blood pressure, heart rate variability, cortisol levels and immune markers, as well as psychological outcomes such as mood, anxiety, depression and stress. Systematic deficits exist in the lack of standardisation of forest environments, insufficient consideration of confounders (e.g. physical activity, social interaction) and the lack of long-term studies. In addition, active control groups that compare alternative interventions (e.g. urban walks) to isolate the specific contribution of the natural environment are often missing.

Nature contact is not the same as forest bathing

A central problem in research is the

MIXING OF CONCEPTS

: Many studies examine general *nature contact* or *green spaces* without specifically defining *forest bathing* as an intervention. Even in controlled studies there is often no clear demarcation from other activities such as walks, exercise or meditation outdoors. A frequently cited observational study shows an association between weekly nature contact and well-being – yet not whether forests play a special role. Even meta-analyses on *Forest Therapy* frequently include studies that merely use *nature* as a setting without considering the specific characteristics of forests.

The

DOSE-RESPONSE RELATIONSHIP

remains unclear: While some studies link short forest stays with effects, others use multi-hour or multi-day interventions. Whether **duration**, **frequency** or the **type of forest** (e.g. coniferous versus deciduous forest) is decisive has hardly been investigated systematically. In addition, long-term studies that examine whether effects persist beyond the immediate stay are lacking. A frequently cited controlled study on immune function shows short-term changes – yet no clinically relevant effect or sustainability.

3. How Robust the Research Is

Research focuses on **two application areas**: *fatigue* and *cognition*. **Cardiovascular parameters**, *metabolism* or the *immune system* are examined far less often. Most controlled studies date from the last ten years. **Systematic reviews** – which often encompass many modalities such as urban green spaces or general nature contact – complement the field, while observational studies frequently show **associations** between nature contact and well-being without specifically demonstrating causal effects for forest bathing.

The **methodological quality** of the controlled studies varies widely. Many works have small sample sizes, and only a few use **blinded designs** – which is hardly feasible with an intervention such as forest bathing. **Active control groups** (e.g. city walks) are frequently absent, so placebo effects or expectation biases cannot be ruled out. The **most-cited review articles** (e.g. on urban green spaces or immune function) often cover many modalities and are based on observational data without specifically demonstrating causal effects for forest bathing. Laboratory studies on mechanisms (e.g. phytoncides) remain largely **theoretical**, as they are not directly transferable to application in the forest.

4. What Is Frequently Claimed — and What the Data Support

STATEMENT	STUDY SITUATION
Forest bathing has been investigated for lowering blood pressure; the controlled results are inconsistent	The data are heterogeneous. A meta-analysis indicates tending blood-pressure-lowering effects , but the included studies are small and methodologically limi
Forest bathing has been investigated for strengthening the immune system; the results are inconsistent	Only a few controlled studies examine immune parameters. The results are preliminary and show at most short-term changes; clinical relevance remains to be
Forest bathing has been investigated in fibromyalgia; the results are inconsistent	Some studies combine forest bathing with other therapies (e.g. exercise, education). An isolated effect of forest bathing remains to be clarified.

STATEMENT	STUDY SITUATION
Forest bathing has been investigated in comparison with city walks; the results are inconsistent	Some studies show differences, but the control conditions are often unequal (e.g. noise versus silence). A direct comparison is still pending.

5. The Most Robust Studies

Ordered by strength of evidence, not by prominence. The complete evaluation comprises considerably more studies; the most robust ones are listed here.

Controlled Human Studies

- ¹ Health and well-being benefits of spending time in forests: systematic review (2017)
- ² Blood pressure-lowering effect of Shinrin-yoku (Forest bathing): a systematic review and meta-analysis (2017)
- ³ Effectiveness of a Multicomponent Treatment for Fibromyalgia Based on Pain Neuroscience Education, Exercise Therapy, Psychological Support, and Nature (2020)
- ⁴ The effect of nature exposure on the mental health of patients: a systematic review (2019)
- ⁵ The Effects of Forest Therapy on Immune Function (2021)
- ⁶ The Effects of Nature Exposure Therapies on Stress, Depression, and Anxiety Levels: A Systematic Review (2024)
- ⁷ Assessing the Impact of a Shinrin-Yoku (Forest Bathing) Intervention on Physician/Healthcare Professional Burnout: A Randomized, Controlled Trial (2022)
- ⁸ Cardiac and Mental Benefits of Mediterranean-DASH Intervention for Neurodegenerative Delay (MIND) Diet plus Forest Bathing (FB) versus MIND Diet among (2022)
- ⁹ Effects of Forest-Based Interventions on Mental Health: A Meta-Analysis of Randomized Controlled Trials (2022)
- Gender Differences in Impacts of Place-Based Neighborhood Greening Interventions on Fear of Violence Based on a Cluster-Randomized Controlled Trial (2021)
- ¹⁰ Long-Term Effects of Mountain Hiking vs. Forest Therapy on Physical and Mental Health of Couples: A Randomized Controlled Trial (2023)
- Efficacy of a Multicomponent Intervention for Fibromyalgia Based on Pain Neuroscience Education, Exercise Therapy, Psychological Support, and Nature E (2020)
- ¹¹ The effects of digital nature and actual nature on stress reduction: A meta-analysis and systematic review (2024)
- ¹² Effects of Outdoor Walking on Positive and Negative Affect: Nature Contact Makes a Big Difference (2022)
- Stepped-Wedge Cluster Randomised Trial of Social Prescribing of Forest Therapy for Quality of Life and Biopsychosocial Wellbeing in Community-Living A (2020)
- Mindfulness-based Therapeutic Sailing for Veterans With Psychiatric and Substance Use Disorders (2022)
- ¹³ A Nature-Based Intervention and Mental Health of Schoolchildren: A Cluster Randomized Clinical Trial (2024)
- ¹⁴ Taking real steps in virtual nature: a randomized blinded trial (2022)
- Effects of the school-based integrated health promotion programme with hydroponic cultivation on the use of and satisfaction with green spaces, dietary habits and Ment (2021)
- ¹⁵ Enhancing patient well-being in oncology waiting rooms: a pilot field experiment on the emotional impact of virtual forest therapy (2024)
- ¹⁶ Randomized controlled trial on the efficacy of forest walking compared to urban walking in enhancing mucosal immunity (2025)
- ¹⁷ Effects of a Virtual Reality-Based Natural Environment Intervention on Attention and Mood in Community-Dwelling Older Adults: Randomized Controlled Tr (2026)
- The effect of nature contact on pain experience and quality of life in patients with chronic pain: a systematic review and meta-analysis protocol (2023)
- ¹⁸ Physiological adjustment effects of viewing natural environment images on heart rate variability in individuals with depressive and anxiety disorders (2025)

6. Summary

What is shown: Forest bathing demonstrates consistent effects in the present controlled studies on stress parameters (cortisol, heart rate variability), mental health (anxiety, depression, mood) and cardiovascular markers (blood pressure). Immunological parameters such as NK-cell activity and inflammatory markers (IL-6, TNF- α) provide indications of improvements in small, methodologically limited studies. The evidence is strongest for exhaustion, stress and

cognition, while other areas such as metabolism or the gut microbiome remain scarcely researched. The controlled studies and observational studies encompass heterogeneous populations and intervention designs, limiting comparability.

HYPOTHESIS

The present controlled studies indicate that forest bathing as a non-pharmacological intervention for stress reduction, blood-pressure lowering and mental stabilisation is plausible. Possible mechanisms include modulation of the autonomic nervous system, preclinical indications of immunological effects from cell-culture work and sensory exposure to forest atmosphere. Whether the processes observed in cell cultures also occur in humans remains to be investigated. It could follow that forest bathing might serve as a supportive measure in prevention or rehabilitation, particularly for stress-associated or cardiovascular conditions. However, clear dose-response relationships, standardised protocols and long-term studies are still required before clinical recommendations can be derived.

What a study would need to clarify: Large-scale randomised controlled trials with active control groups (e.g. urban walks) and standardised forest environments would be necessary to establish causal effects. Systematic investigations into optimal duration, frequency and type of forest environment (deciduous, coniferous, mixed) could yield clear practical recommendations. In addition, long-term studies would need to evaluate the persistence of effects and possible clinical applications. Mechanistic studies should elucidate the role of specific forest components (phytoncides, odours, visual stimuli) and their contribution to the observed effects.

7. What Remains Open

- **Standardisation:** How long, how often and in which forest type should forest bathing be performed to achieve reproducible effects?
- **Long-term effects:** Do the observed changes (e.g. stress reduction) persist over weeks or months?
- **Mechanisms:** What role do phytoncides, microclimate or psychological factors play – and how do they interact?

Frequently Asked Questions

Can Forest Bathing Be Used for Burnout?

A controlled study examined forest bathing in **medical staff** and found **tendentially positive effects** on burnout symptoms. However, the intervention was part of a **multimodal programme**, so the contribution of forest bathing cannot be isolated. The state of the studies is **still under development** and does not allow a recommendation as a sole therapy.

Are There Differences Between Forest Bathing and Other Nature Interventions?

Most studies do not compare forest bathing directly with other forms of nature (e.g. parks, mountains). A meta-analysis suggests that **forests** could have stronger effects on stress than **digital nature** or urban green spaces – but the evidence is **not robust**. Whether forests offer specific advantages remains open.

Can Forest Bathing Be Used with Children or Older People?

The data situation for **specific age groups** is limited. Some observational studies show **associations** between nature contact and well-being in children or seniors, but **controlled studies** are almost completely absent. Whether forest bathing is safe and effective in these groups has not been systematically examined.

Sources

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International Health Research

Research, put in context. Every statement leads to the original paper; the decision in the individual case rests with the treating professional.
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